

# Studies on the Freshwater Oligochaeta of South India<sup>1</sup>

## I. Aeolosomatidae and Naididae

### PART I

BY

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*(With three text-figures)*

### INTRODUCTION

The literature on the freshwater oligochaete fauna of the Indian sub-continent reveals that the group was worked out around Lahore of the North-Western Territory<sup>2</sup> and Calcutta of the Indo-Gangetic Plain area by Stephenson (1907-1925), Annandale (1905-1906), and Mehra (1920-1922), and around Travancore of the Southern Region by Aiyer (1924-1930). As a result of their work, they have recorded 25, 18, and 17 species of worms belonging to Aeolosomatidae and Naididae for the Southern Region, Indo-Gangetic Plain area, and North-Western Territory respectively. Ceylon, Western Region, Main Peninsular Region, Western Himalayan Region, North-East Frontier Region, and Burma are known to have 4, 5, 4, 5, 0, and 3 species respectively (Table I). After 1930 serious work on the group was not undertaken by anybody in the sub-continent.

This paper deals with taxonomic diagnoses of 35 species of worms belonging to 2 families and 10 genera, including a new subfamily and a new genus, 7 new species, 11 new records for the Southern Region, and 2 new records for the Indian sub-continent. The description of each of the species is made from 2 or 3 typical forms, which will be deposited as holotype and syntypes in the Indian Museum, Calcutta, India. The descriptions of new species include a diagnosis of the species.

*Lastockinia* gen. nov. is created to receive an aberrant species *Aeolosoma nieznestnovae* Lastockin (1935). Its diagnosis is given. Stephensonianinae nov. is created here for genus *Stephensoniana* Cernosvitov, which is occupying a solitary position under subfamily Naidinae. With the removal of this genus the Naidinae is more limited than it was according to Sperber.

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<sup>1</sup> Communicated by the Principal, Govt. Arts College, Cuddapah, in November 1959.

<sup>2</sup> This and the other regions mentioned are listed by Stephenson in the FAUNA volume on Oligochaeta (1923).

The other 28 species treated here are : 3 species of *Aeolosoma* belonging to the Aeolosomatidae ; and 3 species of *Chaetogaster*, 1 species each of *Nais*, *Haemonais*, *Stylaria*, *Branchiodrilus*, and *Stephensoniana*, 6 species of *Dero*, 3 species of *Aulophorus*, 2 species of *Allonais*, and 6 species of *Pristina*, all belonging to the Naididae. Their re-descriptions are based on 3 or 4 typical forms of each species (except in *Pristina jenkiniae*), which will be deposited in the Indian Museum.

Keys to the subfamilies of Naididae, to all the genera of Aeolosomatidae, to the subfamilies of the Naididae, and to all the known and valid species of the 10 genera treated here are given.

Complete synonymies of the majority of the species of the Naididae are published by Sperber (1948). Wherever the synonymies established by her are accepted, a repetition has been avoided by citing her paper. Only synonymies established by the author are included. Important papers published subsequent to 1948 are referred to. Complete synonymies are given for the 3 species of the Aeolosomatidae.

The descriptions of new species and re-descriptions of known species include details regarding external characters, setal characters, digestive system, septa, coelomocytes, brain, blood vessels, nephridia, budding zones, sex organs, size of worms, etc. The measurements of the setae and the positions of the nodulus are tabulated for most of the species. Sketches of setae of all the species, and of the brain and nephridia of most of the species are included. In addition the habits of many species, and parasites and commensals of a few species are incorporated.

All the 35 species described here were collected from the following freshwater sources in south India during the periods and visits noted against them :

Localities	Period of collection	No. of visits	No. of species
Bugga Stream, Cuddapah	Sept. '52—April '56 Aug. '57—March '58	Numerous	32
Pullalamadugu Stream, Cuddapah	10.9.1955	One	1
Handri River, Kurnool	9.4.1958	One	1
Balaji Tank, Kakinada	April-Dec. 1956	Three	9
Kandakam Tank, Bellary	April-May 1954	Five	11
Brucepettah Tank, Bellary	April-May 1954	Four	3
Miller's Tank, Bangalore	April-May 1958	Two	2
Langford Town Tank, Bangalore	April-May 1958	Six	9
Ulsoor Tank, Bangalore	April-May 1958	Two	8
Sewage canal across Audagodi-Hosur Road, Bangalore	April-May 1958	One	1

The collections were made from Bugga Stream all round the year during the 4½ years, unlike in other localities. During this period it was found that certain species of worms which are abundant in particular months are scarce or nearly absent in subsequent months, their

place having been taken by some other species of worms. Thus, there is a seasonal variation in the density of populations of all the species of worms round the year.

Asexual reproduction by budding is common in all species and occurs throughout the year. Sexual reproduction is rare, occurring only seasonally. Many species of worms develop sex organs from January to June. During the time that sex organs are developed all the species of worms suspend asexual reproduction except *Stylaria fossularis* and *Pristina longiseta longiseta*, which go through asexual reproduction along with the development of sex organs.

In every freshwater source some freshwater oligochaete or other was collected. From Bugga Stream alone, where collections were made intensively, 32 species of Aeolosomatidae and Naididae, 5 species of Tubificidae<sup>1</sup>, and 1 species of Enchytraeidae<sup>1</sup>, were collected. This number is the world record for a single water source. It is possible that many other water sources would provide as many species of freshwater oligochaetes if intensive collections were undertaken. In others only samples of mud and water were taken and casual examination for freshwater oligochaetes was made. Even such casual examination has yielded between 1 and 11 species from them. From this it is evident that freshwater oligochaetes are available in all fresh waters.

## II. ACKNOWLEDGEMENTS

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<sup>1</sup> These will be dealt with in a subsequent paper.

### III. MATERIAL AND METHODS

**Collection:** The worms inhabiting the aquatic plants, algae, decaying vegetable matter, etc. were collected either by shaking up decaying leaves, wood, cloth, etc. in water in dissection trays or by leaving the algae and aquatic plants in large quantities of water in beakers for a day or two, thus allowing them to settle on the walls of containers, and pipetting them out. The mud-dwellers were collected by washing samples of mud in trays and pipetting the coiled and moving worms from small quantities of water.

**Observation:** Observations were made mainly on living worms. Morphological studies were made chiefly on: the shape, number, position, and lengths of setae; the shape of the gut and brain; the position of the dorsal vessel, the number and position of contractile lateral vessels; the shape, structure, and number of nephridia; the number and position of the budding zones; the position, shape, and structure of the sex organs. The modes of locomotion and habits of the worms were also noted. Fresh setal preparations were made by crushing the worms between cover glass and slide for studying the number, shape, and length of setae. Permanent setal preparations were made by crushing the worms between the cover glass and slide and sealing off with Canada balsam. Many sketches were drawn to measurements and others by the use of the camera lucida.

**Measurements:** All measurements were made using the eye-piece micrometer. The lengths of the setae and the position of the nodulus in the ratio D:P (the length of the shaft distal to the nodulus: the length of the shaft proximal to the nodulus) is given for all the Naididae. When a single measurement is given for the setae, it is the length of the longest seta in the bundle. Needle-setae and hair-setae are referred to as needles and hairs; ventral setae are referred to as crotchets occasionally. When the teeth of needles are equally long, the tooth on the side of the concave curvature is referred to as the inner and the other as the outer. The teeth of the setae are referred to as teeth in needles and as prongs in ventral setae.

### IV. AEOLOSOMATIDAE AND NAIDIDAE OF THE SOUTHERN REGION IN INDIA AND THEIR GEOGRAPHICAL DISTRIBUTION

Stephenson (1923) tabulates only the following six species for the Southern Region: (1) *Nais communis*, (2) *Nais* (= *Allonais*) *pectinata*, (3) *Naidium* (= *Pristina*) *breviseta*, (4) *Pristina longiseta* (= *Pr. longiseta longiseta*), (5) *Branchiodrilus semperi*, and (6) *Br. menoni*. Of these the last named is a synonym of *Br. semperi* (cf. Sperber, 1948). Hence, there were only five valid species of Naididae and no Aeolosomatidae known for the Southern Region till 1923. In Travancore, Aiyer (1925, 1926,

and 1930) recorded 19 more species, Stephenson (1925b) added 2 species, and Sperber (1958) added one species to the region. They are (1) *Aeolosoma bengalense*, (2) *Ae. hemprichii*, (3) *Ae. travancorensis*, (4) *Nais pectinata inaequalis* (= *Allonais inaequalis*), (5) *Naidium* (= *Pristina*) *menoni*, (6) *Pristina aequiseta*<sup>1</sup> (7) *Pr. proboscidea paraguayensis* (= *Pr. proboscidea*), (8) *Stephensonia* (= *Stephensoniana*) *trivandran*, (9) *Slavina appendiculata*, (10) *Dero zeylanica*, (11) *D. limosa* (= *digitata*), (12) *D. austrina* (= *dorsalis*), (13) *D. pectinata*, (14) *D. palmata*, (15) *D. nivea*, (16) *Aulophorus furcatus*, (17) *A. michaelsoni*, (18) *A. tonkinensis*, (19) *Nais* (= *Allonais*) *paraguayensis paraguayensis*, (20) *Aulophorus gravelyi*, (21) *Pristina synclites*, and (22) *Pr. foreli*. Thus, the number of species known for the Southern Region was 27 in 1958. With the 18 species mentioned in the next paragraph the number now stands at 45.

The thirty-five species treated here include 7 new species, and 11 new records for the Southern Region. They are *Nais menoni* sp. nov., *Dero indica* sp. nov., *D. plumosa* sp. nov., *Aulophorus hymanae* sp. nov., *A. indicus* sp. nov., *Allonais rayalaseemensis* sp. nov., and *Pristina sperberae* sp. nov.; *Chaetogaster diastrophus* (Gruithuisen), *Ch. langi* Bretscher, *Ch. crystallinus* Vejdovsky, *Stylaria fossularis* Leidy, *Haemonais waldvogeli* Bretscher, *Dero cooperi* Stephenson, *D. sawayai* Marcus, *Allonais gwaliorensis* (Stephenson), *Pristina minuta* (Stephenson), *Pr. aequiseta* Bourne, and *Pr. jenkiniae* (Stephenson). Of these *Dero sawayai* and *Pristina jenkiniae* are new records for the Indian sub-continent. As a result 45 species are known for the Southern Region and 53 species for the Indian sub-continent.

TABLE I

DISTRIBUTION OF AEOLOSOMATIDAE AND NAIDIDAE IN THE NINE GEOGRAPHICAL REGIONS OF THE INDIAN SUB-CONTINENT

	Ceylon	Southern Region	Western Region	Main Peninsular Region	Indo-Gangetic Plain area	North-western Territory	Western Himalayan Region	North-east Frontier Region	Burma
	I	II	III	IV	V	VI	VII	VIII	IX
AEOLOSOMATIDAE									
1. <i>Aeolosoma bengalense</i> *	..	+			+				
2. <i>Ae. hemprichii</i> *	..	+				+			
3. <i>Ae. viridae</i>	..					+			
4. <i>Ae. travancorensis</i> *	..	+							
5. <i>Ae. ternarium</i> <sup>2</sup>	..	+							

<sup>1</sup> This was an incorrect identification. The species was really *Pr. evelinae*.

<sup>2</sup> Doubtful validity.

\* Species treated in this paper.

TABLE I—(contd.)

	Ceylon	Southern Region	Western Region	Main Peninsular Region	Indo-Gangetic Plain area	North-western Territory	Western Himalayan Region	North-east Frontier Region	Burma
	I	II	III	IV	V	VI	VII	VIII	IX
NAIDIDAE									
6. <i>Chaetogaster diastrophus</i> *		+				+			+
7. <i>Ch. langi</i> *		+	+		+				
8. <i>Ch. diaphanus</i>						+			
9. <i>Ch. cristallinus</i> *		+			+				
10. <i>Ch. limnei limnei</i>							+		+
11. <i>Ch. limnei bengalense</i>					+	+			+
12. <i>Nais communis</i> *		+	+		+	+	+		
13. <i>N. menoni</i> sp. nov.*		+							
14. <i>N. barbata</i>					+				
15. <i>N. elinguis</i>					+				
16. <i>N. raviensis</i>						+			
17. <i>Slavina appendiculata</i>		+			+	+	+		
18. <i>Stylaria fossularis</i> *		+			+	+	+		
19. <i>Haemonais waldvogeli</i> *		+			+	+			
20. <i>Branchiodrilus semperi</i> *		+							
21. <i>Br. hortensis</i>					+	+			
22. <i>Dero dorsalis</i> *		+							
23. <i>D. digitata</i> *		+							
24. <i>D. indica</i> sp. nov.*		+							
25. <i>D. zeylanica</i> *	+	+							
26. <i>D. cooperi</i> *		+			+	+			
27. <i>D. nivea</i> *		+							
28. <i>D. sawayai</i> *		+							
29. <i>D. pectinata</i>		+							
30. <i>D. plumosa</i> sp. nov.*		+							
31. <i>D. palmata</i>		+							
32. <i>Aulophorus furcatus</i> *		+	+			+			
33. <i>A. michaelseni</i> *	+	+							
34. <i>A. hymanae</i> sp. nov.*		+							
35. <i>A. gravelyi</i>		+							
36. <i>A. indicus</i> sp. nov.*		+							
37. <i>A. tonkinensis</i> *	+	+			+		+		
38. <i>Allonais inaequalis</i> *		+			+				
39. <i>Al. paraguayensis paraguayensis</i>									
40. <i>Al. rayalaseemensis</i> sp. nov.*		+		+	+	+			
41. <i>Al. gwaliorensis</i> *		+		+					
42. <i>Al. pectinata</i>		+		+	+				
43. <i>Stephensoniana trivandranata</i> *		+							
44. <i>Pristina minuta</i> *		+				+			
45. <i>Pr. menoni</i>		+							
46. <i>Pr. jenkiniae</i> *		+							
47. <i>Pr. synclites</i> *		+							
48. <i>Pr. breviseta</i>		+							
49. <i>Pr. aequiseta</i> *		+				+	+		
50. <i>Pr. evelinae</i> *		+							
51. <i>Pr. longiseta longiseta</i> *		+	+	+	+	+			
52. <i>Pr. proboscidea</i>		+			+				
53. <i>Pr. foreli</i>		+							
54. <i>Pr. sperberae</i> sp. nov.*		+							
	4	45	5	4	19	17	5	0	3

\* Species treated in this paper

TABLE II

GEOGRAPHICAL DISTRIBUTION OF AELOSOMATIDAE AND NAIDIDAE

	Australia	Asia	Africa	Europe	America	
					North	South
<b>AELOSOMATIDAE</b>						
1. <i>Aeolosoma bengalense</i> ..		+				+
2. <i>Ae. hemprichii</i> ..		+	+	+	+	+
3. <i>Ae. travancorensis</i> ..		+				+
<b>NAIDIDAE</b>						
4. <i>Chaetogaster diastrophus</i> ..		+		+	+	+
5. <i>Ch. langi</i> ..		+	+	+	+	+
6. <i>Ch. crystallinus</i> ..		+	+	+	+	+
7. <i>Nais communis</i> ..		+	+	+	+	+
8. <i>Stylaria fossularis</i> ..		+		+	+	
9. <i>Haemonais waldvogeli</i> ..		+		+	+	+
10. <i>Branchiodrilus semperi</i> ..		+				
11. <i>Dero dorsalis</i> ..		+		+		+
12. <i>D. digitata</i> ..		+	+		+	+
13. <i>D. zeylanica</i> ..		+				
14. <i>D. cooperi</i> ..		+	+			+
15. <i>D. nivea</i> ..		+		+		
16. <i>D. sayayai</i> ..		+				+
17. <i>Aulophorus furcatus</i> ..	+	+	+	+	+	+
18. <i>A. michaelsoni</i> ..		+				
19. <i>A. tonkinensis</i> ..		+	+			+
20. <i>Allonais inaequalis</i> ..		+	+			+
21. <i>Al. gwaliorensis</i> ..		+	?+			
22. <i>Stephensoniana trivandranana</i> ..		+				
23. <i>Pristina minuta</i> ..		+			+	+
24. <i>Pr. synclites</i> ..		+				
25. <i>Pr. jenkiniae</i> ..		+	+			+
26. <i>Pr. aquiseta</i> ..		+	+	+	+	+
27. <i>Pr. evelinae</i> ..		+		+		+
28. <i>Pr. longiseta longiseta</i> ..	+	+	+	+		+
	2	27	13	14	11	19

## V. SYSTEMATICS

## Family AELOSOMATIDAE

Aeolosomatidae has only three valid genera, viz. *Hystricosoma* Michaelsen, 1926; *Aeolosoma* Ehrenberg, 1831; and *Potamodrilus* Lastockin, 1935. The very aberrant species *Aeolosoma nieznestnovae* Lastockin, 1935, without setae and with paired lateral tubercles on the body-wall and two post-anal appendages, does not fit into the genus *Aeolosoma* characterised by the presence of setae and by the absence of paired tubercles on the body-wall and post-anal appendages. I agree with the view

of Marcus (1944) that a fourth genus is necessary to receive this aberrant species. As its presence in *Aeolosoma* is incongruous and as it does not fit into either *Hystricosoma* or *Potamodrilus*, the two other genera in the family, a new genus *Lastockinia* after the late Dr. D. A. Lastockin is created to receive it.

Genus *Lastockinia* gen. nov.

Generic type : *Lastockinia nieznestnovae* (Lastockin)

Prostomium not separated by a well-defined groove from the rest of the body, broader than following segments. External segmentation indistinct. Setae absent. Paired lateral tubercles and two post-anal appendages present. Skin glands usually present. Paratomy occurs.

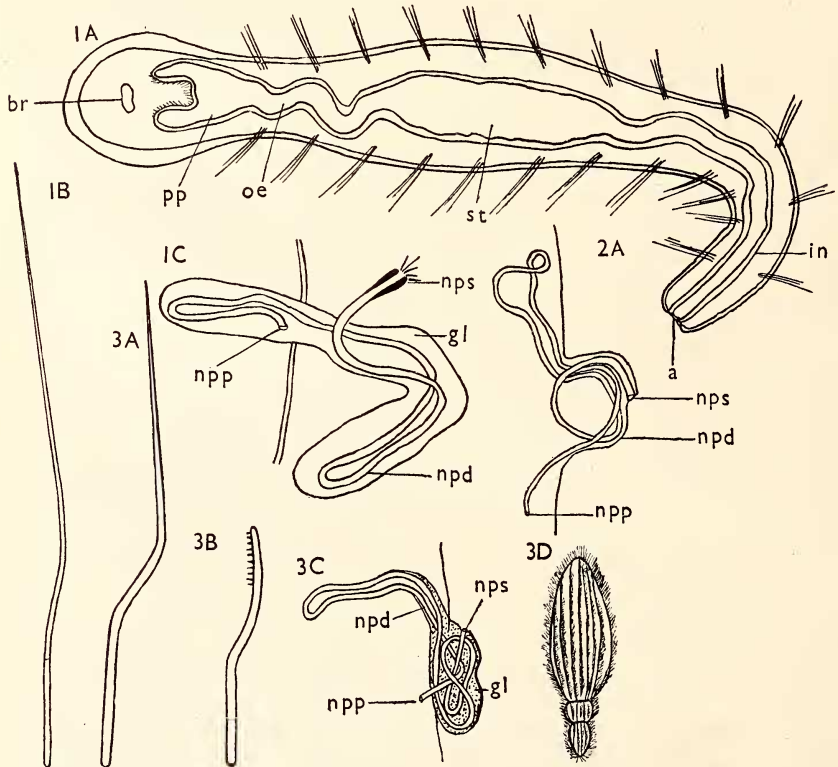


Fig. 1. *Aeolosoma bengalense* Stephenson: A. Entire worm (ventral view); B. Hair seta  $\times 705$ ; C. Nephridium. Fig. 2. *Aeolosoma hemprichii* Ehrenberg: A. Nephridium. Fig. 3. *Aeolosoma travancorensis* Aiyer: A. Hair seta  $\times c. 1000$ . B. Needle seta  $\times c. 1000$ . C. Nephridium. D. Holotrichous Ciliate parasite, *Radiophryoides*.

a : anus; br : brain; gl : gland; in : intestine; npd : nephridial duct; npp : nephridiopore; nps : nephrostome; oe : oesophagus; pp : pharynx; st : stomach.



## KEY TO ALL THE GENERA OF AEOLOSOMATIDAE

- A-1 Setae present ; paired tubercles absent on body-wall  
 B-1 Prostomium separated from the body by a well-defined groove .. *\*Hystricosoma*  
 B-2 Prostomium not separated from body by well-defined groove  
 C-1 Body provided with glandular post-anal appendage ; worms attached .. *\*Potamodrilus*  
 C-2 Body without post-anal appendage ; worms not attached .. *Aeolosoma*  
 A-2 Setae absent ; paired tubercles present on body-wall .. *\*Lastockinia* gen. nov.

1. Genus *Aeolosoma* Ehrenberg, 1831

*Generic characters* : Eyes absent. Prostomium not separated from the body by well-defined groove, semi-circular, flat with or without lateral sensory ciliary pits. Skin glands coloured or colourless. Dorsal and ventral setae from II on, composed of hairs or hairs and needles. Pharynx funnel-shaped, oesophagus thin, stomach conspicuous, gut entirely ciliated ; intestinal anti-peristalsis and ascending ciliary vibration occur. Septa absent. Blood colourless ; dorsal vessel mid-dorsal and contractile ; ventral vessel mid-ventral and non-contractile ; lateral contractile vessels absent. Nephridia paired, start in II or III. Budding zones 1-4 or more ; produce prostomium and some anterior segments to posterior zooid, and some hind segments to anterior zooid, before fission.

KEY TO THE KNOWN AND VALID SPECIES OF *AEOLOSOMA*

- A-1 Secretions of skin glands coloured  
 B-1 Secretions of skin glands red, orange or dark garnet  
 C-1 Needle setae present  
 D-1 Needle setae smooth, present in ventral bundles only ; skin glands red, present dorsally .. *\*evelinae*  
 D-2 Needle setae toothed in dorsal and ventral bundles ; skin glands present dorsally and ventrally, light red .. *\*corderoi*  
 C-2 Needle setae absent  
 E-1 All the setae of a bundle are equal in length .. *\*quarternarium*  
 E-2 Setae of bundles are of different lengths  
 F-1 Skin glands reddish, occurring only dorsally ; stomach in V-XI .. *\*gertae*

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\* Genera not known from the Indian sub-continent

F-2	Skin glands reddish, occurring both dorsally and ventrally; stomach in VI-VII		
G-1	Ciliated pits present on prostomium; skin glands red	..	<i>hemprichii</i>
G-2	Ciliated pits absent on prostomium; skin glands red and green	..	<i>*kashyapi</i>
B-2	Secretions of skin glands yellow, green, lemon, olive or blue-green		
H-1	Needle setae present		
I-1	Needle setae smooth		
J-1	Needle setae present from III	..	<i>*leidy</i>
J-2	Needle setae present from V	..	<i>*tenebrarum</i>
I-2	Needle setae serrated		
K-1	Skin glands yellowish orange; teeth on convex border of needle setae distally	..	<i>*japonica</i>
K-2	Skin glands bright yellow; teeth on concave border of needle distally	..	<i>*sawayai</i>
H-2	Needle setae absent		
L-1	Zone of fission between VII and X		
M-1	Skin glands yellow	..	<i>*flavum</i>
M-2	Skin glands yellowish green		
N-1	Nephridia begin in II	..	<i>viridae</i>
N-2	Nephridia begin in III		
O-1	Nephridial funnel narrow; n=8-9	..	<i>*variegatum</i>
O-2	Nephridial funnel wide; n=10	..	<i>*pointneri</i>
L-2	Zone of fission between XI and XV		
P-1	Stomach upto XI	..	<i>*headleyi</i>
P-2	Stomach upto VIII		
Q-1	Ciliated fields present on dorsal surface of prostomium; body-diameter 0.2-0.3 mm.	..	<i>bengalense</i>
Q-2	Ciliated fields absent; body-diameter 0.06-0.1 mm.	..	<i>*aureum</i>
A-2	Secretions of skin glands colourless		
R-1	Needle setae present		
S-1	Needle setae serrated (under oil immersion)	..	<i>travancorensis</i>
S-2	Needle setae smooth	..	<i>*beddardi</i>
R-2	Needle setae absent	..	<i>*niveum</i>

### 1. *Aeolosoma bengalense* Stephenson, 1911

Fig. 1, A, B.

*Aeolosoma bengalense* Stephenson, 1911, p. 204.

*Aeolosoma bengalense* Stephenson, Stephenson, 1923, p. 41; 1930, p. 136. Aiyer, 1926, p. 131, fig. 1-3. Michaelsen & Boldt, 1932, p. 590. Marcus, 1944, pp. 16-17,

\* Species not known from the Indian sub-continent

fig. 5 A, B. Du-Bois Raymond Marcus, 1944, p. 5, fig. 11-12. Yamaguchi, 1953, pp. 280-281, fig. 1.

*Aeolosoma* sp. 1. Stephenson, 1931b, p. 298.

*Material examined*: Numerous worms collected from the Bugga Stream, Cuddapah in July 1955, and from Ulsoor Tank, Bangalore, in May 1958.

Worms (Fig. 1 A) whitish and of medium size. Prostomium with sensory hairs, wider than anterior segments, about equal to the widest body-diameter, with ventral ciliation and two small dorso-lateral ciliated sensory pits. Body-wall colourless and transparent with skin glands of larger, variously shaped, dirty yellow or greenish yellow, and of smaller ovoid blue colour.

Dorsal and ventral bundles composed of hairs and needles; hairs (Fig. 1 B) bayonet-shaped, non-serrate, 280-350  $\mu$  long, 1-4 per bundle dorsally, and 200-220  $\mu$  long, 4-7 per bundle ventrally; needles non-serrate, bayonet-shaped, 140-180  $\mu$  long, 3-4 per bundle dorsally; 100-120  $\mu$  long, 4-6 per bundle ventrally.

Mouth ventral, V-shaped. Pharynx in II, funnel-like. Oesophagus in III, thin and wavy. Stomach in IV- $\frac{1}{2}$ VIII, fusiform and bright yellow. Intestine thin and wavy.

Brain ovoid with constrictions medially in front and behind.

Dorsal vessel arises in IV, runs dorsally over oesophagus and pharynx, divides into two, descends on either side of the pharynx and unites with non-contractile ventral vessel in II. Blood flows from behind forwards in dorsal and from anterior to posterior in ventral vessels.

First nephridial pair in II, last in IX or X. Nephridium (Fig. 1 C) has a minute funnel with a ciliated nephrostome, followed by a long coiled ciliated duct passing through glandular mass and opening to exterior by nephridiopore ventro-laterally. Cilia in the nephrostome and nephridial duct beat down the lumen.

Worms with 1-4 budding zones common. Some hind segments to the anterior zooid, and prostomium and a few anterior segments to the posterior zooid are budded before fission. As the first budding zone is proliferating segments to both the zooids, second, third, and fourth budding zones are developed, second zone in front of the first, third behind the first, and fourth anterior to the second zone.

Sexual worms not encountered.

l (preserved)=1.0-1.2 mm.; d (preserved)=0.2 mm.; s=12-15;  
n=9-10.\*

*Distribution in Indian sub-continent*: Calcutta (N. India); Travancore (S. India). Now recorded from Cuddapah and Bangalore (S. India).

*Habits*: No swimming. Glides on substratum like Turbellarians.

\* l=length; d=diameter; s=number of segments of each worm; and n=number of segments behind which budding zone develops.

2. *Aeolosoma hemprichii* Ehrenberg, 1831

Fig. 2 A

*Aeolosoma hemprichii* Ehrenberg. Gervais, 1838, p. 14. Beddard, 1895, p. 183. Smith, 1900, p. 443. Michaelsen, 1900, p. 14; 1905, p. 305. Bretscher, 1906, p. 6. Pointner, 1911, p. 627. Piguët, 1913, pp. 112-113. Lastockin, 1918, p. 57; 1924, p. 4; 1927, p. 65. Svetlov, 1926, p. 250. Oye, 1927, p. 359. Ude, 1929, pp. 18-19. Cernovitov, 1930, p. 9. Kondo, 1936, p. 382. Kenk, 1941, p. 6. Marcus, 1944, pp. 21-22, fig. 7 A, B. Chen, 1944, p. 1. Causey, 1953a, p. 55. Yamaguchi, 1957, pp. 161-163, fig. 1.

*Aeolosoma venustum* Leidy, 1850, p. 46, pl. II, fig. 8-12.

*Aeolosoma pictum* Schmarda, 1861, p. 10, pl. XVII, fig. 155.

*Aeolosoma stokesii* Cragin, 1887, p. 31.

*Aeolosoma kashyapi* Stephenson. Aiyer, 1926, p. 138.

*Aeolosoma hemprichii* var. *kashyapi* Stephenson. Chen, 1940, pp. 23-24, fig. 1a.

*Material examined*: Numerous worms collected from the Bugga Stream, Cuddapah in October and December 1955; from the Balaji Tank, Kakinada in December 1956; from the Kandakam Tank, Bellary in April 1954 and 1956.

Worms minute, transparent, colourless and invisible to naked eye. Integument has numerous spherical and ovoid deep red cutaneous glands, scattered irregularly dorsally and ventrally, with concentration in prostomium and anal segment. Prostomium wider than body diameter, with marginal sensory hairs, ventral ciliation and lateral sensory ciliated pits. Its margin is highly mobile, constantly curling up and down as the worm glides along the substratum.

Each seta-bundle has 3-5 bayonet-shaped hairs only; when 3, central hair longer than others, when 4, alternate ones longer, when 5, 3 longer and 2 shorter. Longer hairs 90-120  $\mu$  long.

Mouth semi-circular with a thick ciliated rim. Pharynx in II, short and funnel-shaped. Oesophagus in III, thin. Stomach in IV-VI, barrel-shaped and brown. Intestine thin and sinuous from VII. Food material rotates on its axis during its course through the gut. Coelomocytes translucent, ovoid or spindle-shaped.

Brain dumb-bell-shaped.

Dorsal vessel mid-dorsally attached to gut, divides anteriorly into two, branches unite with non-contractile ventral vessel below the pharynx.

Nephridia two per segment from II or III to IX. Nephridium (Fig. 2 A) is a long coiled ciliated duct with a ciliated nephrostome anteriorly opening into the coelom, the duct traverses glandular mass and ends by nephridiopore.

Worms with 2-4 budding zones common.

l (living)=1.8 mm.; d (living)=0.06 mm.; s=12-14; n=7-8.

*Distribution in Indian sub-continent*: Travancore (S. India); Lahore (Pakistan). Now recorded from Cuddapah, Bellary, Kakinada (S. India).

*Remarks* : Stephenson (1909a) identified the Lahore aeolosomatids with deep orange skin glands as *Ae. hemprichii* and separated them as *Ae. kashyapi* (1923) purely on the basis of their small size and the presence of equally long setae in the bundles. Ciliated pits are stated to be absent (Stephenson, 1909a). This important character was overlooked by him in his diagnosis of *Ae. kashyapi* and he created the new species on the differences in size and setae from *Ae. hemprichii*. Aiyer (1926) also failed to observe this important character. Examining both *Ae. kashyapi* and *Ae. hemprichii* in Brazil, Marcus (1944) found ciliated pits absent in the former and present in the latter. He distinguished the two species mainly on the presence and absence of the ciliated pits. He also found a few greenish skin glands among the red ones in *Ae. kashyapi*. Brazilian worms are 2 mm. long, Japanese worms are 1.5 mm. long (Yamaguchi, 1957) and Chinese worms are 3 mm. long (Chen, 1940). Bayonet-shaped hairs and needles observed in the present worms were not pointed out by the previous writers.

*Habits* : Swimming absent ; gliding occurs. Backward progression by series of jerks.

### 3. *Aeolosoma travancorense* Aiyer, 1926

#### Fig. 3 A-D

*Aeolosoma travancorense* Aiyer, 1926, p. 136; 1930, pp. 16-19, fig. 1. Stephenson, 1930, pp. 723, 725. Marcus, 1944, pp. 24-25, fig. 11, 12, 15, 75.

*Material examined* : Many worms collected from the Bugga Stream, Cuddapah in November 1953, June 1954 and December 1955.

Worms minute, whitish and live in tubes larger than themselves, made of sand, mud and mucus. Integument with colourless ovoid skin glands. Prostomium wider than body diameter and highly flexible. Prostomium and anal segment bear sensory hairs.

Dorsal and ventral bundles composed of hairs and needles. In II all are hairs, from III needles replace hairs, middle segments have 2-3 needles and 2-3 hairs, hind segments have all needles. Hairs (Fig. 3 A) are bayonet-shaped, 63-80  $\mu$  long. Needles (Fig. 3 B) are thicker and half as long as hairs, bayonet-shaped, 35-38.5  $\mu$  long, with one row of 10-12 teeth in the concave border distally.

Mouth ventral, four-cornered and ciliated. Pharynx in II, funnel-shaped. Oesophagus in III, thin and wavy. Stomach in IV-VII, wide, orange coloured. Intestine thin and ciliated, opening posteriorly in anus. Coelomocytes absent.

Brain dumb-bell-shaped.

Dorsal vessel mid-dorsal and contractile ; ventral vessel mid-ventral and non-contractile. No contractile vascular loops.

First pair of nephridia in III ; nephridium (Fig. 3 C) is a long coiled, ciliated duct with a ciliated nephrostome opening in the coelom, a minute nephridiopore opening to exterior ventrolaterally, and proximal half of the duct compactly coiled and enclosed in gland tissue.

Budding zones 1-3 common ; provide some hind segments to the anterior zooid and prostomium and head segments to the posterior zooid before they separate.

l (living)=1.0 mm. ; d (living)=0.07 mm. ; s=12-13 ; n=7-8.

*Distribution in Indian sub-continent* : Travancore (S. India). Now recorded from Cuddapah (S. India).

*Parasites* : In the gut of several worms astomatous ciliates belonging to genus *Radiophryoides* (Fig. 3 D) are harboured as parasites. They are light green in colour in life, with flatly ovoid body, 160-180  $\mu$  long, 70-78  $\mu$  wide and 35-40  $\mu$  thick, with longitudinal rows of cilia. They move slowly rotating on their axes. Several ciliates have 1-2 buds attached posteriorly.

*Remarks* : Aiyer (1926) states the presence of two rows of very minute teeth in the concave border of the needles. I could see only one row of them under oil immersion. The ciliate parasites have been found by Aiyer (1930) in his worms.

*Habits* : No swimming. Moves by gliding.

(To be continued)